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मानक

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IS 15702 (2006): Automotive vehicles - Air brake hose [TED
4: Automotive Braking Systems]



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भारतीय मानक
स्वचल वाहन — वायु ब्रेक होज — विशिष्टि

Indian Standard
AUTOMOTIVE VEHICLES — AIR BRAKE
HOSE — SPECIFICATION

ICS 43.040.40

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Braking Systems, Vehicle Testing and Performance Evaluation Sectional Committee had been approved by the Transport Engineering Division Council.

The purpose of this standard is to reduce the probability of accidents occurring as a result of brake system failure from pressure loss due to hose rupture.

The composition of the Committee responsible for the formulation of this standard is given at Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

AUTOMOTIVE VEHICLES — AIR BRAKE HOSE — SPECIFICATION

1 SCOPE

This standard specifies performance requirements for motor vehicle air brake hose, brake hose assemblies, and brake hose end fittings.

This standard applies to any motor vehicle including two, three, four wheelers and multi-wheelers incorporating pneumatic brake systems using brake hose.

2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

<i>IS No.</i>	<i>Title</i>
3400 (Part 6) : 1983	Methods of test for vulcanized rubbers: Part 6 Resistance to liquids (<i>first revision</i>)
9844 : 1981	Methods of testing corrosion resistance of electroplated and anodized aluminium coatings by neutral salt spray test

3 DEFINITIONS

3.1 Armour — Protective material installed on a brake hose to increase the resistance of the hose or hose assembly to abrasion or impact damage and bursting.

3.2 Brake Hose — A flexible conduit, other than a vacuum tubing connector, manufactured for use in a brake system to transmit or contain the fluid pressure or vacuum used to apply force to a vehicle's brakes.

3.3 Brake Hose Assembly — A brake hose, with or without armour equipped with end fittings for use in a brake system.

3.4 Brake Hose and Fitting — A coupler designed for permanent attachment to the ends of a brake hose by crimping or swaging.

3.5 Leaks, Burst — The loss of transmission fluid

through the brake hose assembly other than by the designed inlet(s) and outlet(s).

3.6 Free Length — The linear measurement of hose exposed between the end fittings of a hose assembly while maintained in a straight position by hanging a weight of 500 g.

3.7 Cracking — The discontinuity of a surface due to environment and/or stress.

3.8 Rupture — Any failure that results in separation of a brake hose from its end fitting or in leakage or in burst.

4 REQUIREMENTS

4.1 Construction

Each air brake hose assembly shall be equipped with permanently attached brake hose end fittings or reusable brake hose end fittings. Each air brake hose intended for use with reusable end fittings shall be free from defects such as air blisters, porosity that affects the performance of the hose and shall conform to the dimensional requirements specified in Table 1.

4.2 Constriction

Except for that part of end fitting which does not contain hose, every inside diameter of any section of an air brake hose assembly when measured with vernier calliper as per 4.2.1 shall be not less than 75 percent of the nominal inside diameter of the hose for heavy duty (Type II) or 70 percent of the nominal inside diameter of the hose for light duty (Type I).

4.2.1 The inside diameter shall be determined as the mean of two measurements taken at right angles to each other in one plane across the hose, measured at least 25 mm from the end. For bulk inspection the internal diameter of the hose shall be checked with a plug gauge of 'Go' and 'No Go' type to see that it is within the specified tolerance.

4.3 High Temperature Resistance

An air brake hose shall not show external or internal cracks, charring or disintegration visible without magnification when straightened after being bent for 70 ± 1 h at $100 \pm 2^\circ\text{C}$ as per the test procedure given in 4.3.1.

4.3.1 A mandrel having the radius indicated in Table 2

Table 1 Air Brake Hose Dimensions for Reusable Assemblies
(Clause 4.1)

All dimensions in millimetres.

Sl No.	Size	I.D. Tolerance	Type I O.D.		Type II O.D.	
			Minimum	Maximum	Minimum	Maximum
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	4.76	+ 0.66 - 0	11.99	12.95	12.7	13.69
ii)	6.35	+ 0.78 - 0	13.59	14.55	14.27	15.29
iii)	7.94	+ 0.78 - 0	15.19	16.15	16.66	17.65
iv)	9.53	+ 0.78 - 0	18.26	19.83	18.26	19.84
v)	10.32	+ 0.78 - 0	18.14	19.30	18.85	20.04
vi)	12.7	+ 0.99 - 0	20.52	21.69	22.81	24.00
vii)	15.88	+ 1.06 - 0	23.70	24.86	26.77	27.96
viii)	12.7 Special	+ 0.78 - 0	21.44	23.01	21.44	23.01

shall be selected for the size of the hose tested. The test hose shall be wound around the mandrel and conditioned in an air oven for 70 h at 100°C. The hose shall be removed from the mandrel and straightened. The hose shall then be examined externally and after cutting the hose lengthwise the inner tube shall be examined.

4.4 Low Temperature Resistance

The outer cover of an air brake hose shall not show cracks visible without magnification as a result of conditioning at -40°C for 70 ± 1 h when bent around a cylinder having the radius specified in Table 2 for the size of hose when tested as per 4.4.1.

4.4.1 Utilize a cylinder having the radius indicated in the Table 2 (for air brake hose) for the size of hose to be tested. Condition the cylinder and the hose in a straight position in a cold chamber at -40°C for 70 ± 1 h. With the hose and cylinder at -40°C, bend the hose 180° around the cylinder at a steady rate in a period of 3 to 5 s.

4.5 Ozone Resistance

The outer cover of an air brake hose shall not show cracks visible under seven times power magnification after exposure to ozone for 70 ± 1 h as per procedure given in 4.5.1.

4.5.1 The hose in the bent form around a mandrel, the diameter of which shall be eight times the nominal outside diameter of the hose shall be exposed to ozone concentration of 50 ± 5 parts per hundred million (pphm) by volume for 72 h. The ozone chamber shall have an ambient temperature of 40°C during test. The hose then shall be examined under seven times power magnification, ignoring areas immediately adjacent to or within the area covered by binding.

4.6 Burst Strength

There shall be no hose burst or end fitting separation below 6.21 MPa when hose or hose assemblies are subjected to a hydrostatic burst test.

Table 2 Air Brake Hose Diameters and Test Cylinder Radii
(Clauses 4.3.1, 4.4 and 4.4.1)

All dimensions in millimetres.

Hose, Nominal Diameter	4.76	6.35	7.94	9.53	10.32	11.11	12.7	15.88
Radius of Test Cylinder	50.8	63.5	76.2	88.9	88.9	101.6	101.6	114.3

4.7 Length Change

An air brake hose shall not contract, in length more than 7 percent nor elongate more than 5 percent when subjected to air pressure of 1.38 MPa as specified in 4.7.1.

4.7.1 A test hose shall be positioned in a straight horizontal position. An air pressure of 0.07 MPa shall be applied. The original free length shall then be measured. Without releasing the 0.07 MPa air pressure, air pressure shall be raised to 1.37 MPa. The final free length is measured under this pressure. An elongation or contraction as an increase or decrease respectively in the final free length from the original free length of the hose shall be calculated.

4.8 Adhesion

Except for hose reinforced by wire, an air brake hose shall withstand a tensile force of 14.7 N per cm of length before separation of adjacent layers when tested as per procedure given in 4.8.1. For wire reinforced the method is as per 4.8.2.

4.8.1 Apparatus

Utilize a power driven apparatus of the inclination balance or pendulum type which is constructed so that:

- Recording head includes a freely rotating form with an outside diameter substantially the same as the inside diameter of the hose specimen to be placed on it;
- Freely rotating form is mounted so that its axis of rotation is in the plane of the ply being separated from the specimen and so that the applied force is perpendicular to the tangent of the specimen circumference at the line of separation;
- Rate of travel of the power actuated grip is a uniform 25 mm/min and the capacity of the machine is such that maximum applied tension during the test is not more than 85 percent nor less than 15 percent of the machine's rated capacity;
- Machine operates with no device for maintaining maximum load indication, and in a pendulum type machine, the weight level swings as a free pendulum without engagement of pawls; and
- Machine produces a chart with millimetres of separation as one coordinate and applied tension as the other.

4.8.1.1 Preparation

- Cut a test specimen of 25 mm or more in length from the hose to be tested and cut the layer to be tested of that test specimen longitudinally along its entire length to the level of contact with the adjacent layer.
- Peel the layer to be tested from the adjacent layer to create a flap large enough to permit attachment of the clamp of the apparatus.
- Mount the test specimen on the freely rotating form with the separated layer attached to the power-actuated clamp.

4.8.1.2 Calculation

- Adhesion value shall be the minimum force recorded on the portion of the chart corresponding to the actual separation of the part being tested.
- Express the force, in N/cm of length.

4.8.2 Adhesion of Wire Reinforced Hose

The requirements and method of testing cover adhesion shall be the same as 4.8.1 for all other hose types. The integrity of the inner tube adhesion shall be tested by subjecting a length of hose not less than 381 mm long to the following requirements.

Place a steel ball of the size specified in Table 3 in the bore of the hose. One end shall then be attached to a vacuum source and the other end plugged. A vacuum of 635 mm of mercury shall be applied for a period of 5 min while the hose is in an essentially straight position. At the conclusion of this period and while still under vacuum, the hose shall be bent 180° to the minimum bend radius as indicated in Table 2 in each of two directions 180° apart. After bending and returning to an essentially straight position and while still under vacuum, the ball shall be rolled from end to end of the hose. Failure of the ball to pass freely from end to end shall be indication of separation of the tube from the reinforcement layer and shall constitute failure.

4.9 Zinc Chloride Resistance

The outer cover of an air brake hose shall not show cracks visible under seven power magnification after immersion in a 50 percent zinc chloride aqueous solution for 200 h as stipulated in 4.9.1.

Table 3 Steel Ball Sizes
(Clause 4.8.2)

Hose I.D. mm (inch)	4.7 (3/16)	6.4 (1/4)	7.9 (5/16)	9.5 (3/8)	10.3 (13/32)	11.1 (7/16)	12.7 (1/2)	15.9 (5/8)
Ball Size mm (inch)	3.6 (9/64)	4.8 (3/16)	6.0 (15/64)	7.1 (9/32)	7.5 (19/64)	8.3 (21/64)	9.5 (3/8)	11.9 (15/32)

4.9.1 Immerse an air brake hose in a 50 percent zinc chloride aqueous solution at room temperature for 200 h. Remove it from the solution and examine it under seven power magnification for cracks.

4.10 End Fitting Corrosion Resistance

After 24 h of exposure to salt spray, as per **4.10.1** air brake hose end fitting shall show no base metal corrosion on the end fitting surface except where crimping or the application of label information causes a displacement of the protective coating.

4.10.1 A salt spray chamber of the following design shall be used for salt spray test to find the end fitting corrosion resistance:

- a) Construction material used for the chamber shall not be affected by the corrosiveness of the salt spray fog.
- b) Hose assembly shall be supported or suspended 30° from the vertical and parallel to the principal direction of the horizontal flow of fog through the chamber.
- c) Hose assembly shall not contact any metallic material or any material capable of acting as a wick.
- d) Condensation which falls from the assembly shall not return to the solution reservoir for respraying.
- e) Condensation from any source shall not fall on the brake hose assemblies or the solution collectors.
- f) Spray from the nozzles is not directed on to the hose assembly.

4.10.2 Preparation

- a) Plug each end of the hose assembly.
- b) Mix a salt solution five parts by weight of sodium chloride to 95 parts of distilled water, using sodium chloride substantially free of nickel and copper, and containing on a dry basis not more than 0.1 percent of sodium iodide and not more than 0.3 percent total impurities. Ensure that the solution is free of suspended solids before the solution is atomized.
- c) After atomization at 35°C, ensure that the collected solution is in the pH range of 6.5 to 7.2. Make the pH measurements at 25°C.
- d) Maintain a compressed air supply to the nozzle or nozzles free of oil and dirt and between 0.7 to 1.8 kg/cm² pressure.

4.10.3 Operation

Subject the brake hose assembly to the salt spray for every cycle of 24 ± 1 h.

- a) Regulate the mixture so that each collector will collect from 1 to 2 ml of solution per hour for each 80 cm² of horizontal collecting area.

- b) Maintain exposure zone temperature at 35°C.
- c) Upon completion, remove the salt deposit from the surface of the hoses by washing gently or dipping in clean running water not warmer than 38°C and then drying immediately.

4.11 Proof Pressure Test

Assemblies subjected to a pressure test using 2.07 ± 0.07 MPa air or nitrogen under water for a minimum of 30 s shall show no leaks.

4.12 Tensile Strength

An air brake hose assembly designed for use between frame and axle or between a towed and a towing vehicle shall withstand without separation of the hose from its end fittings, a pull of 114 kg if it is 6.35 mm or less in nominal internal diameter, or a pull of 150 kg if it is larger than 6.35 mm nominal internal diameter.

4.12.1 Operation

A tension testing machine conforming to the requirements of the testing capable of generating and recording upto 500 kg of tension shall be used for tensile test. The hose assembly shall be mounted in such a manner that a straight and evenly distributed machine pull is ensured. Tension is applied at the rate of 25 mm/min travel of the moving head until separation occurs.

4.13 Resistance to Oil

When tested as per IS 3400 (Part 6) the specimens prepared from the inner tube and the cover shall show a volume increase of not more than 100 percent when measured after removal from Oil No. 3 in which it has been immersed for 70 ± 2 h at 100 ± 2°C.

4.14 Resistance to Water

Condition hose assembly by immersion in tap water at room temperature for a period of 168 ± 2 h while bent over a form having the minimum bend radius. Ends shall be completely capped during immersion. Then all the tests will be done in the following manner as indicated in Table 4. The requirements will remain same as for the previous tests.

4.15 Flexure Test

4.15.1 Preparation of Test Samples

4.15.1.1 Prior to cutting the hose, apply a layline (of a colour distinguishable from that of the hose cover) along the length of the hose following the natural hose curvature which results from the hose being coiled in a roll (see Fig. 1).

4.15.1.2 Cut the hose to provide a hose assembly sample

Table 4 Sequence of Tests for Resistance to Water
(Clause 4.14)

Sample No. (1)	Subjected to (2)	Followed by (3)
1	Constriction test	High temperature resistance and proof pressure test
2	Constriction test	Low temperature resistance and proof pressure test
3	Resistance to oil	—
4	Constriction test	Water resistance and assembly tensile strength
5	Ozone resistance	—
6	Constriction resistance	Salt spray test and burst strength
7	Constriction test	Length change then proof pressure and burst strength
8	Adhesion test	—
9	Flexure test	—

with a free hose length as shown in Fig. 2. Free hose length is the outside exposed hose length between the fittings in the finished hose assembly.

4.15.1.3 Fittings are to be assembled on the hose in accordance with the manufacturer's instructions.

4.15.2 Preconditioning

Subject each sample hose assembly to the reconditioning specified in 4.15.2.1, followed by the preconditioning specified in 4.15.2.2.

4.15.2.1 Salt spray conditioning

With the ends plugged, subject the hose assembly samples to 24 ± 1 h exposure to salt spray testing in accordance with IS 9844.

4.15.2.1.1 Allow not more than 168 h elapsed time between completion of salt spray conditioning and the starting of high temperature aging as per 4.15.2.2.

4.15.2.2 High temperature aging

With each hose assembly sample in a straight position, age the samples in air at a temperature of $100 \pm 1^\circ\text{C}$ for a period of 70 ± 2 h. During the entire conditioning period, the hose bore of each sample is to be exposed to the air within the oven.

4.15.2.2.1 Allow not more than 168 h elapsed time between completion of high temperature aging and starting of flex tests as per 4.15.3 and 4.15.4.

4.15.3 Installation of Samples in the Test Setup

After the samples have been preconditioned, they are to be installed in the test setup in the configuration specified in Fig. 2 and Table 5. The installation procedure is as follows:

4.15.3.1 With the movable manifold of the flex test machine at the center of its stroke, fitting 'B' is connected to the movable manifold in such a manner that the layline

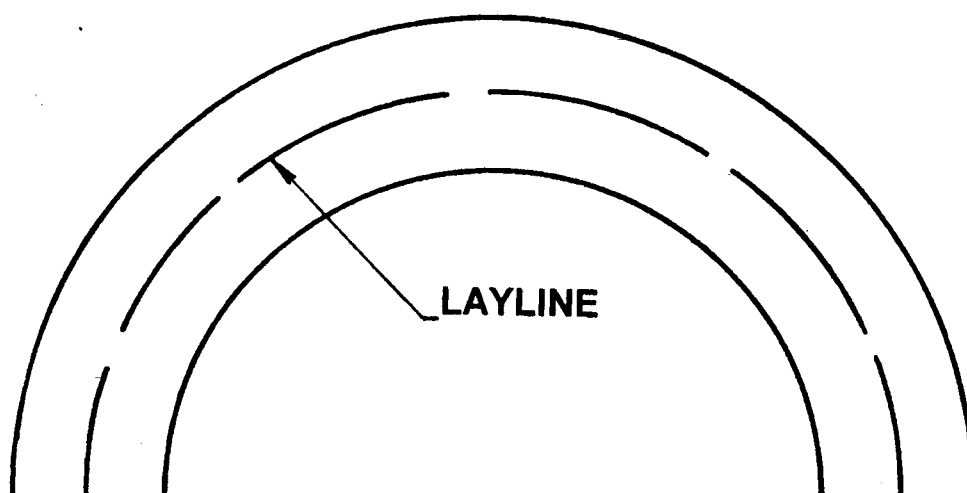
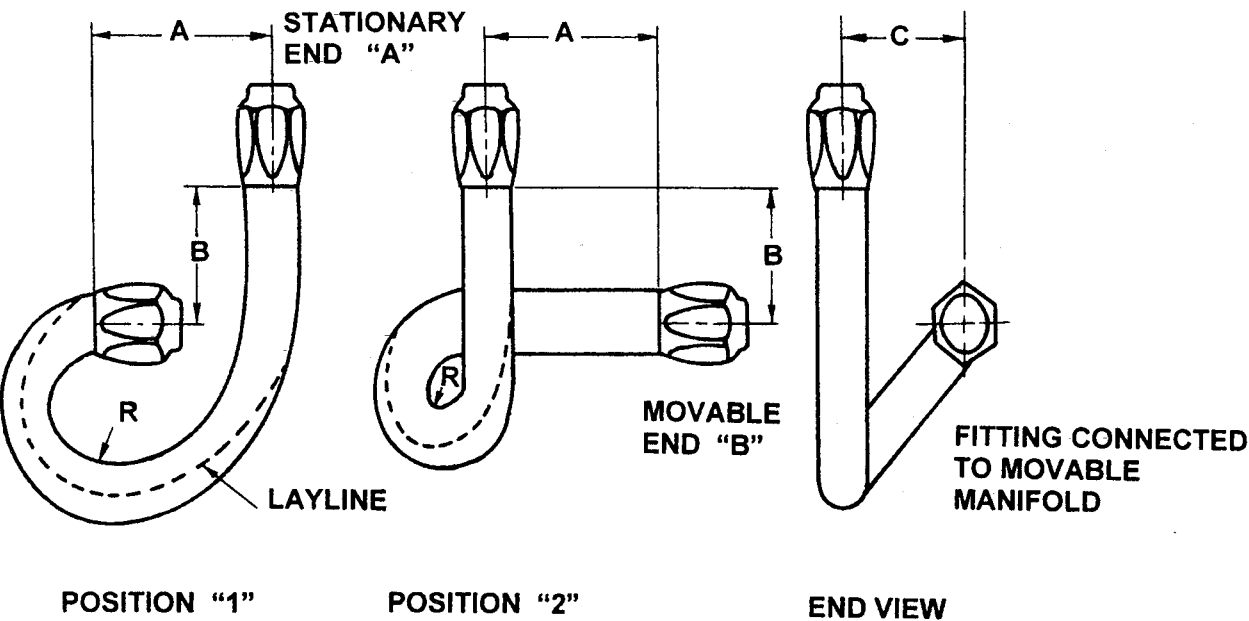


FIG. 1 LAYLINE



Position "1" illustrates the "Left" extreme of travel
Position "2" illustrates the "Right" extreme of travel

FIG. 2 POSITION OF THE HOSE PIPE

Table 5 Position of Hose Pipe
(Clause 4.15.3)

All dimensions in millimetres.

Sl No.	Free Hose Length ± 1.6	Hose I.D.	Dimensions							
			Position '1'				Position '2'			
			A	B	C	R	A	B	C	R
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	254	4.8, 6.3	76	70	95	34	76	70	95	30
ii)	279	7.9, 9.7, 10.4	76	89	114	43	76	89	114	33
iii)	355	11.2, 12.7, 16.0	76	102	127	56	76	102	127	46

is located at the top-center position (see Fig. 2).

4.15.3.2 After fitting 'B' has been coupled with the movable manifold, the fitting 'A' is then connected to the stationary manifold without imparting any twist to the hose, but allowing the hose to seek its natural curvature.

4.15.4 Test Procedure

Flex the samples by moving fitting 'B' from the centre stroke position to 76 mm either side of center ('A' dimension in Fig. 2) alternating between Position '1' and

'2' while simultaneously cycling the air pressure on for 1 min and off for 1 min.

4.15.4.1 Flexure/pressure cycling test parameters

- a) Total flexure stroke = 152 ± 1.6 mm.
- b) Flexure stroke frequency = 100 ± 5 cpm.
- c) Room temperature (temperature to be recorded).
- d) Internal air pressure on test samples = 1.03 ± 0.07 MPa. The air pressure shall be alternately fully 'ON' for $1 \text{ min} \pm 5 \text{ s}$ and fully 'OFF' for $1 \text{ min} \pm 5 \text{ s}$.

4.15.5 The failure point (number of flex stroke cycles) shall be determined by loss of air pressure through the failed sample. As the air pressure is alternately fully 'ON' for 1 min and fully 'OFF' for 1 min, pressure loss shall be further described as failure of the system to be repressurized to 1.03 ± 0.07 MPa through a $1.6^{+0.03}_{-0.00}$ mm diameter orifice within 2 min. Failure shall not occur before completing one million flex cycles.

5 SAMPLING

5.1 Lot

In any consignment, all the lengths of assembled brake hose of the same type, size and diameter, produced under essentially similar conditions of manufacture (such as those from single batch of raw materials or from components obtained from a single source or from a single production method) shall be separated into groups and each such group shall constitute a lot.

5.2 Scale of Sampling

5.2.1 Tests for the determination of the conformity of a lot to the requirements of this standard on assembled brake hoses shall be carried out for each lot separately. The number of lengths of assembled hoses to be selected for this purpose shall be in accordance with col 2 and 3 of Table 6.

5.2.2 The required number of lengths of assembled hoses shall be selected at random from the lot. For this purpose, a suitable number of bundles in the lot shall be chosen first and from each of the bundles so chosen not more than 5 lengths shall be taken out at random so as to obtain the desired numbers indicated in col 4 of Table 6.

5.3 Tests for Characteristics Requiring Non-destructive Testing

5.3.1 Hose lengths selected according to 5.2.2 shall be tested for the following requirements:

- a) Visual examination for defects like air blister, porosity and other surface defects (*see 4.1.2*),

- b) Dimensional requirements (*see 4.1.2*),
- c) Constriction (*see 4.2*),
- d) Temperature resistance (*see 4.3 and 4.4*),
- e) Ozone resistance (*see 4.5*),
- f) Length change test (*see 4.7*), and
- g) Air pressure test (*see 4.11*).

Each length shall be measured for free length (that is, distance between couplings). Any length found unsatisfactory with regard to one or more of the above characteristics shall be considered as defective.

5.3.1.1 If the number of defective lengths is greater than the corresponding number of permissible defective lengths given in col 4 of Table 6, the lot shall be rejected.

5.4 Tests for Characteristics Requiring Destructive Testing

5.4.1 From each of the lots which are found to satisfactory according to 5.2.1.1 on lengths of assembled brake hoses for each lot containing more than 1 500 lengths, shall be chosen at random from those already selected (*see 5.1.3*) for carrying out each of the following tests:

- a) Burst strength (*see 4.6*),
- b) Adhesion (*see 4.8*),
- c) Zinc chloride test (*see 4.9*),
- d) End fitting corrosion test (*see 4.10*),
- e) Tensile strength (*see 4.12*),
- f) Resistance to oil (*see 4.13*),
- g) Resistance to water (*see 4.14*), and
- h) Flexure test (*see 4.15*).

5.4.1.1 The lot shall be declared as conforming to the requirements of this standard, if the test results for the determination of different characteristics are found satisfactory. In case test results for any characteristic fail to meet the relevant requirement of this standard, two more tests for each lot containing 1 500 lengths or less and four more tests for each lot containing more than 1 500 lengths,

Table 6 Scale of Sampling
(Clauses 5.2.1 and 5.2.2)

Sl No. (1)	Lot Size (in Lengths) (2)	Sample Size (in Lengths) (3)	Permissible Number of Defective Lengths (4)
i)	Up to 1 000	25	1
ii)	1 001 to 1 500	35	1
iii)	1 501 and above	50	2

shall be conducted for that characteristic and only on finding all these tests satisfactory, the lot shall be considered as conforming to the requirements of that characteristics, otherwise not.

6 MARKING

6.1 Each length of the hose shall be legibly and indelibly marked with the following:

- a) Manufacturer's name or trade-mark, if any;
- b) Hose denomination;
- c) Batch number; and
- d) Month and year of manufacture.

6.2 BIS Certification Marking

The material may also be marked with the Standard Mark.

6.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to the manufacturers or producers may be obtained from the Bureau of Indian Standards.

7 PACKING

The hoses shall be packed in the manner as agreed to between the manufacturer and the purchaser.

ANNEX A (Foreword)

COMMITTEE COMPOSITION

Automotive Braking Systems, Vehicle Testing and Performance Evaluation Sectional Committee, TED 4

<i>Organization</i>	<i>Representative(s)</i>
Vehicle Research & Development Establishment (VRDE), Ahmednagar	DR N. KARUPPAIAH (<i>Chairman</i>)
Allied Nippon Ltd, Sahibabad	SHRI VIJAY KUMAR SHRI RAJESH GOYAL (<i>Alternate</i>)
Ashok Leyland Ltd, Chennai	SHRI R. R. G. MENON
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Automotive Research Association of India, Pune	SHRI S. S. SANDHU SHRI A. AKBAR BADUSHA (<i>Alternate</i>)
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Bosch Chassis Systems India Limited, Pune	SHRI S. S. PATLI SHRI D. N. MANDORE (<i>Alternate</i>)
Brakes India Ltd, Chennai	SHRI P. VENUGOPAL SHRI K. KANABIRAN (<i>Alternate</i>)
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Central Institute of Road Transport, Pune	SHRI T. R. MHETRE SHRI N. R. KACHARE (<i>Alternate</i>)
Central Road Research Institute, New Delhi	DR T. S. REDDY DR SANTOSH A. JALIHAI (<i>Alternate</i>)

<i>Organization</i>	<i>Representative(s)</i>
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Hindustan Motors Ltd, Hooghly	SHRI U. K. KINI SHRI M. G. JHINGRAN (<i>Alternate</i>)
HMT Ltd, Pinjore	SHRI DEEPAK MEHTA SHRI HIMANSU PURSHOTAM (<i>Alternate</i>)
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Ministry of Road Transport and Highway, New Delhi	SHRI B. BHANOT
Rane Brake Linings Ltd, Chennai	SHRI S. BADRINARAYANAN SHRI L. RAMASAMY (<i>Alternate</i>)
Royal Enfield, Chennai	SHRI N. KRISHNAN SHRI R. ANBUSELVAN (<i>Alternate</i>)
Scooter India Ltd, Lucknow	SHRI P. D. JOSHI SHRI C. M. MEHTA (<i>Alternate</i>)
Society of Indian Automobile Manufacturers, New Delhi	SHRI K. K. GANDHI MS BHUVANESWARI JAYARAMAN (<i>Alternate</i>)
Sundaram Brake Linings Ltd, Chennai	SHRI G. R. CHANDRAMOULI SHRI K. N. RAVI (<i>Alternate</i>)
Sundaram Clayton Ltd, Chennai	SHRI S. SELVAMANI SHRI G. NARAYANAMURTHY (<i>Alternate</i>)
Swaraj Mazda Ltd, Ropar	SHRI S. R. AGARHARI
Tata Motors Limited, Pune	SHRI G. NAGABHUSHAN
Toyota Kirloskar Motors Pvt Ltd, Bangalore	SHRI K. E. TAKAVALE SHRI YOGA PRASAD (<i>Alternate</i>)
Tractor Manufacturers Association, New Delhi	SHRI S. LAKSHMIPATHY SHRI K. KANNIBARAN (<i>Alternate</i>)
TVS Motor Co Ltd, Hosur	SHRI S. RAMIAH

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Vehicle Research & Development Establishment, Ahmednagar	SHRI K. KAMRAJ SHRI SAM SHAIKH (<i>Alternate</i>)
Volvo India Pvt Ltd, Bangalore	SHRI ARNE KNABEN SHRI S.V. SUDERSON (<i>Alternate</i>)
Yamaha Motor India Pvt Ltd, Faridabad	SHRI B. SARKAR SHRI P. K. SEHGAL (<i>Alternate</i>)
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